
Collaborative Virtual Prototyping (CVP) and Cost-As-An-Independent-Variable (CAIV)

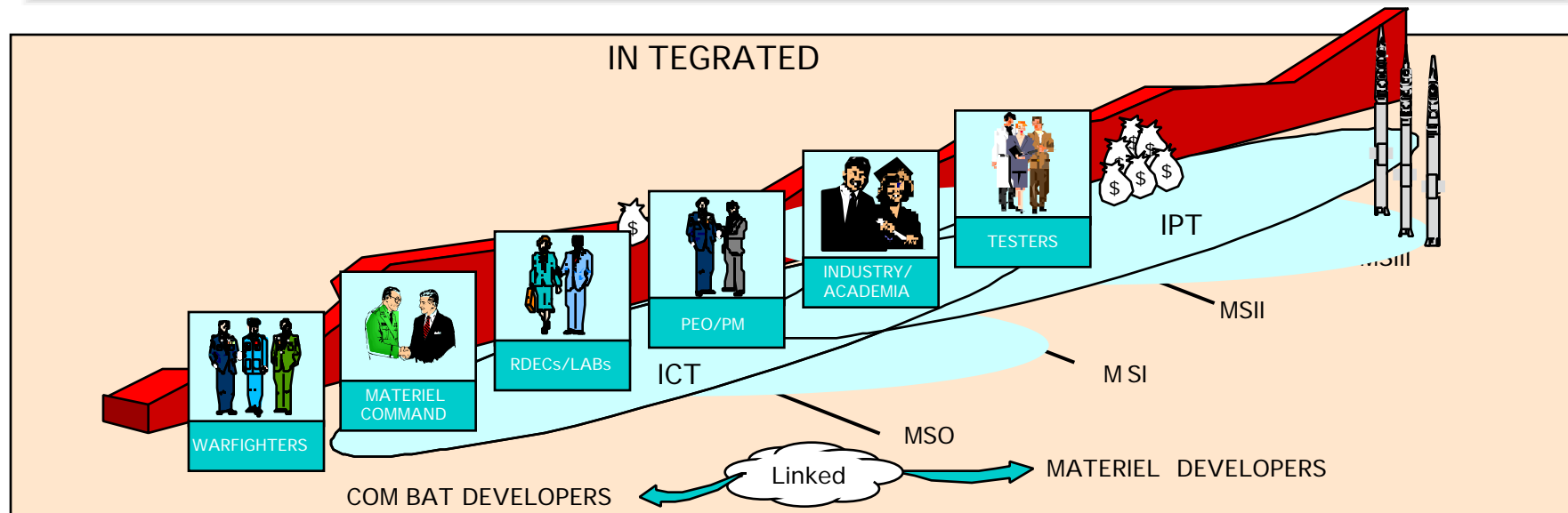
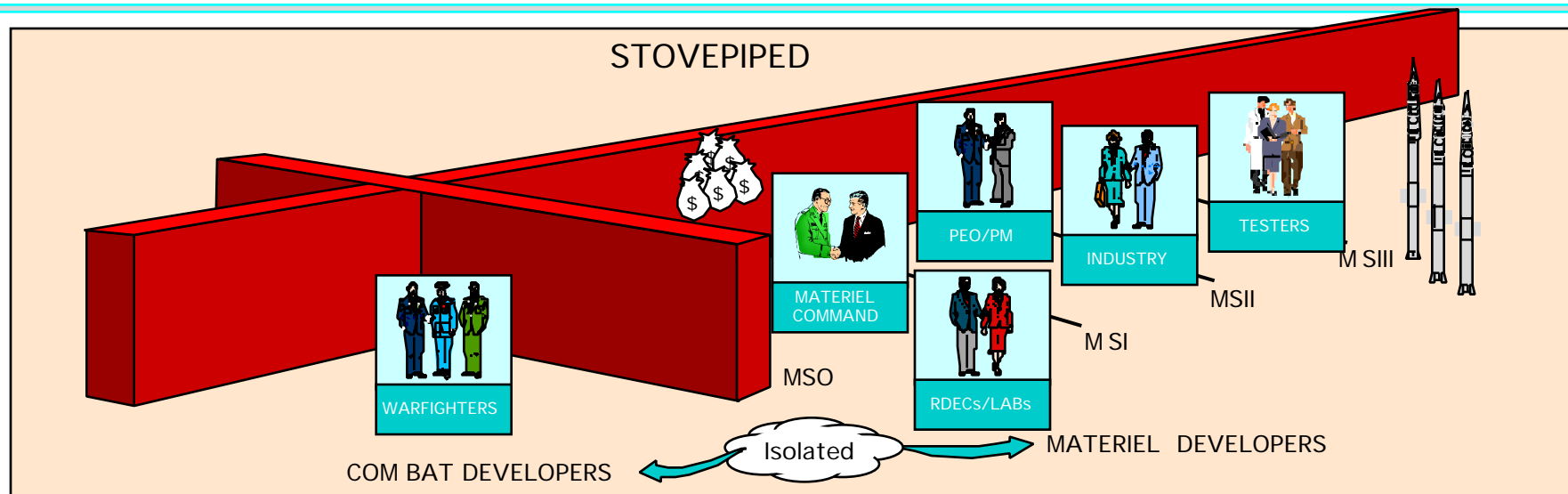


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MATERIEL DEVELOPMENT AND ACQUISITION PROCESS



COST-AS-AN-INDEPENDENT-VARIABLE (CAIV) MANDATE

“Cost as an independent Variable (CAIV). The acquisition process described in DoDD 5000.1 and DoD 5000.2-R must consider both performance requirements and fiscal constraints. Accordingly, cost must also be an independent variable in programmatic decisions, with responsible cost objectives set for each program phase.”

**PAUL KAMINSKI
UNDER SECRETARY OF DEFENSE
(ACQUISITION AND TECHNOLOGY)**



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COST-AS-AN-INDEPENDENT-VARIABLE (CAIV)

- COST-AS-AN-INDEPENDENT-VARIABLE (CAIV)
 - PROGRAM PARAMETERS
 - REQUIREMENTS
 - PERFORMANCE
 - SCHEDULE
 - COST
- CAIV MEANS MAKING **PERFORMANCE** AND **SCHEDULE** A FUNCTION OF AVAILABLE (BUDGETED) RESOURCES
- COST-AS-AN-INDEPENDENT-VARIABLE IS AN ACQUISITION STRATEGY FOCUSING ON **COST-PERFORMANCE TRADE-OFFS IN SETTING PROGRAM GOALS**
- CAIV MEANS PICKING THE RIGHT AFFORDABLE COST OBJECTIVE, AND STICKING TO IT. PREFERABLY **PRIOR TO MILESTONE I**



AFFORDABLE MULTI-MISSILE MANUFACTURING (AM3) PROGRAM

MISSION:

- **TO DEVELOP, VALIDATE, AND IMPLEMENT INNOVATIVE DESIGN, MANUFACTURING, BUSINESS PRACTICE, AND SYSTEM CONCEPTS THAT WILL SUBSTANTIALLY REDUCE THE COST OF DoD'S PORTFOLIO OF TACTICAL MISSILE AND SMART MUNITIONS ACQUISITION PROGRAMS**

PHASED PROGRAM:

- **PHASE I: 9 MONTH CONCEPT DEFINITION (7/95 - 3/96)**
- **PHASE II: 15 MONTH CONCEPT VALIDATION (4/96 - 6/97)**
- **PHASE III: 36 MONTH IMPLEMENTATION (7/97 - 6/00)**



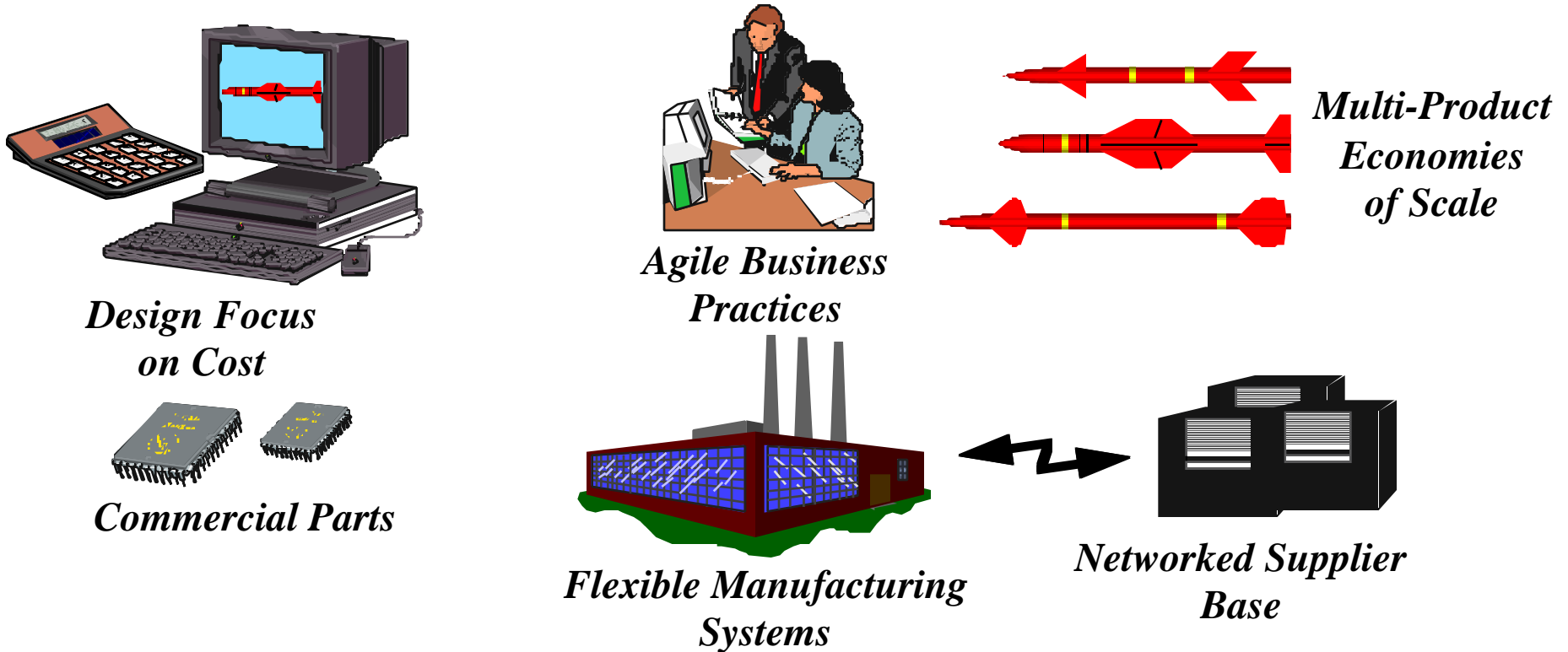
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EXECUTIVE SUMMARY

Affordable Multi-Missile Manufacturing



Objective

- **Prototype New Combinations of Multi-Use Designs, Flexible Manufacturing Technology and World Class Business Practices**
- **Demonstrate Feasibility of Saving 25-50% Across Missile Portfolio**
- **Leave in Place a Competitive Base of Capabilities for DoD**



EVOLUTION

- **FOREIGN GOVERNMENT**

- MISSILE NOT MEETING EXPECTATIONS
- LACK OF DESIGN INFORMATION
- FUNDED EXPERT ANALYSIS SYSTEM (7M\$; INITIATED 1993)
- VALIDATED WITH FLIGHT TEST DATA
- EXAMINING TECHNOLOGY INSERTION ALTERNATIVES

- **DoD ACQUISITION REFORM**

- DECLINING BUDGETS
- INTEGRATED CONCEPT/PRODUCT TEAMS (ICTs/IPTs)
- INTEGRATED PRODUCT AND PRODUCT DEVELOPMENT (IPPD)
- COST-AS-AN-INDEPENDENT-VARIABLE (CAIV)

- **DARPA PROGRAMS**

- RAPID DESIGN EXPLORATION AND OPTIMIZATION (RaDEO)
- AFFORDABLE MULTI-MISSILE MANUFACTURING (AM3)

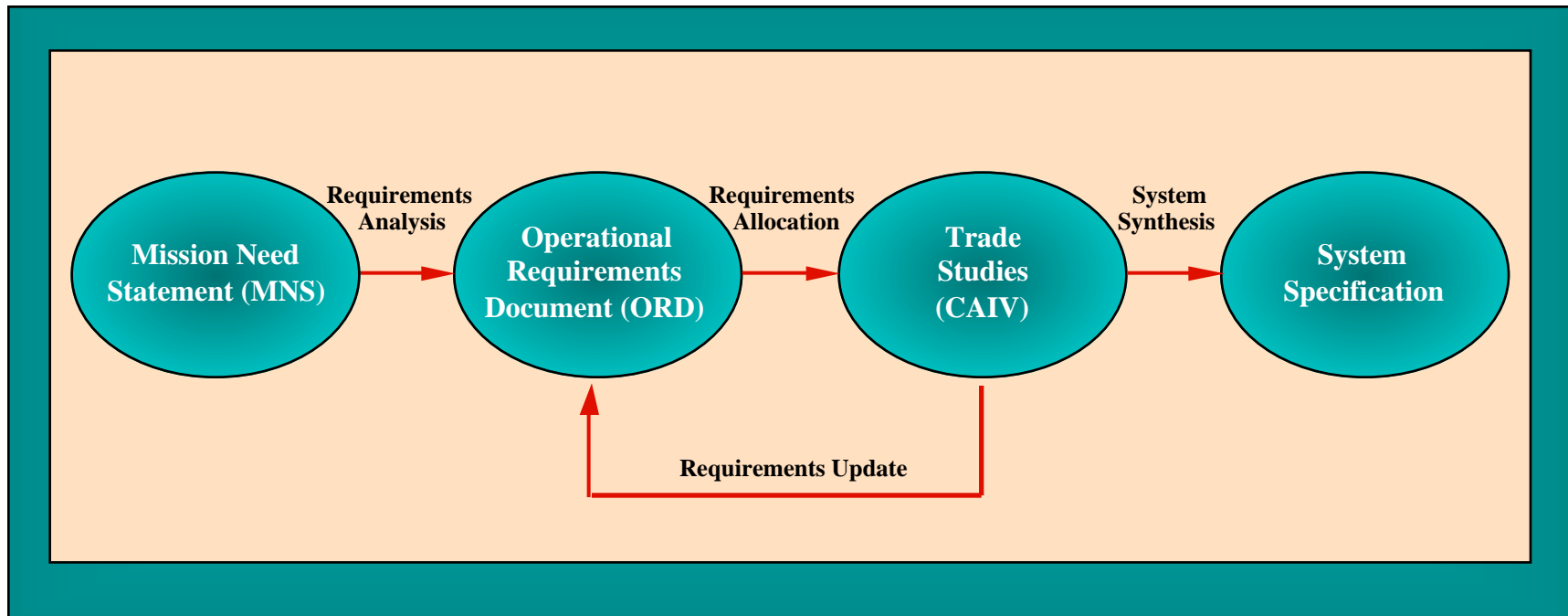
- **PROJECT OFFICE SUPPORT**

- CAPABILITY READY FOR APPLICATION

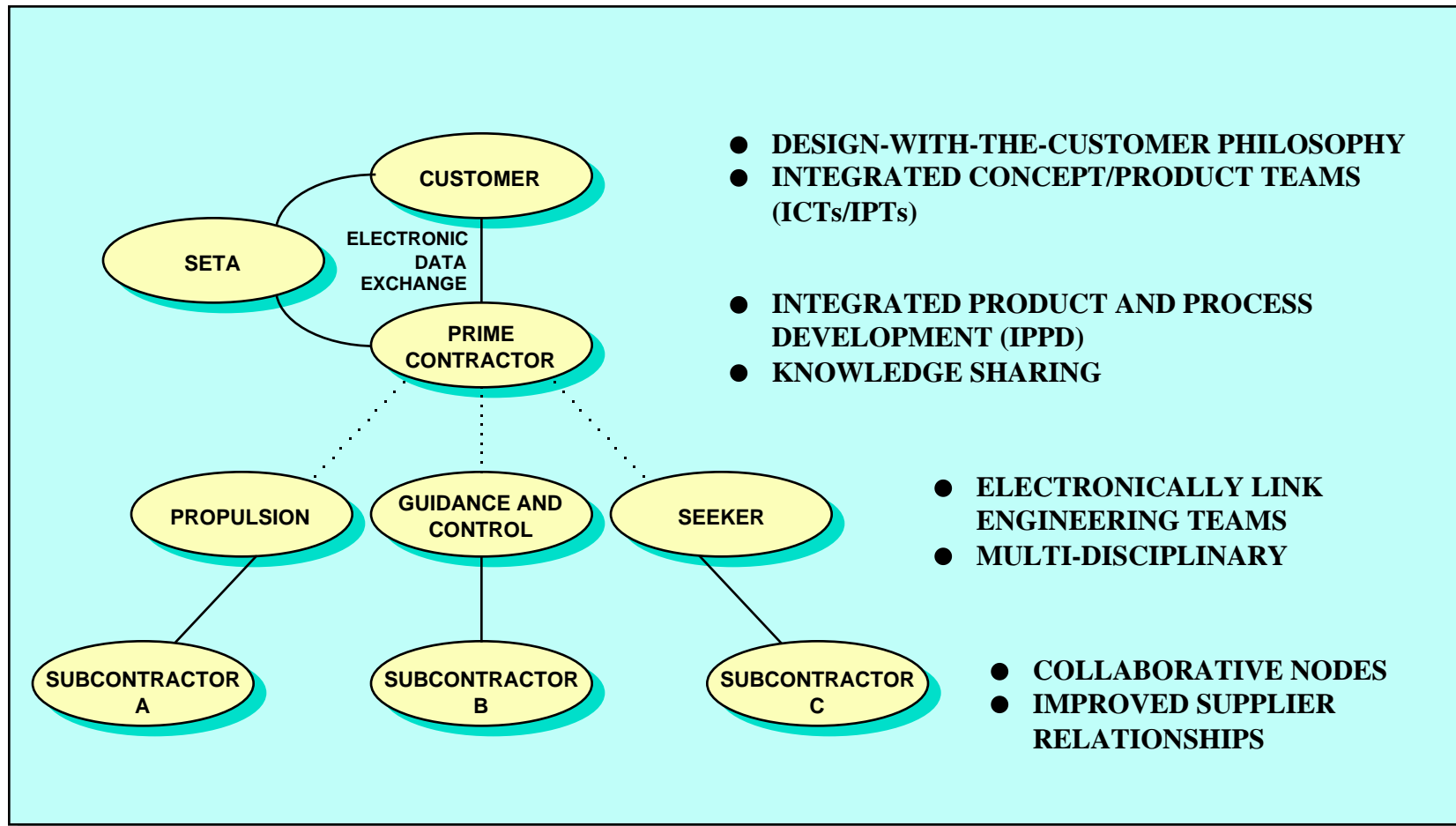


EXECUTIVE SUMMARY

Process Flow



COLLABORATIVE ENGINEERING

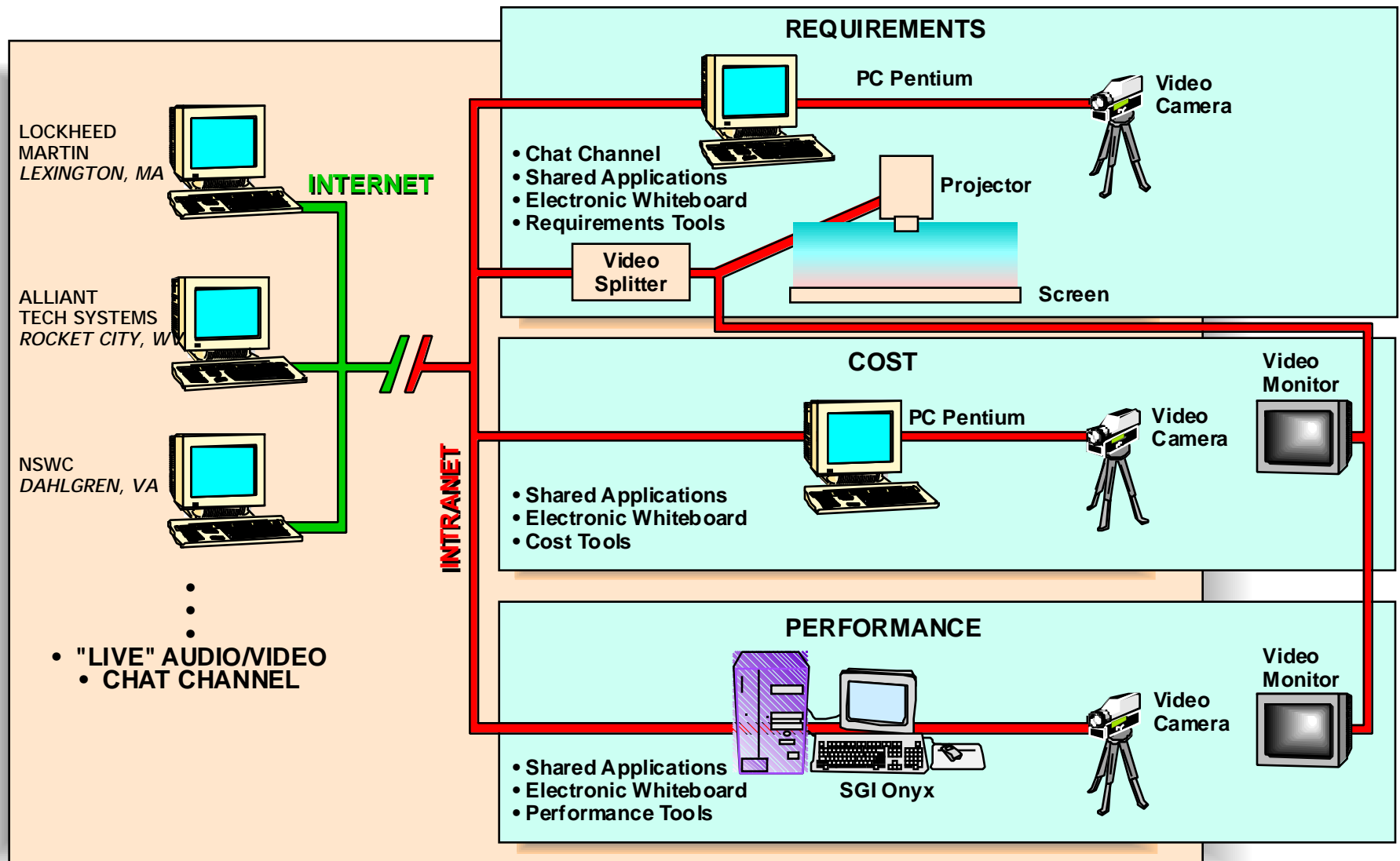


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AM3 VALIDATION NETWORK



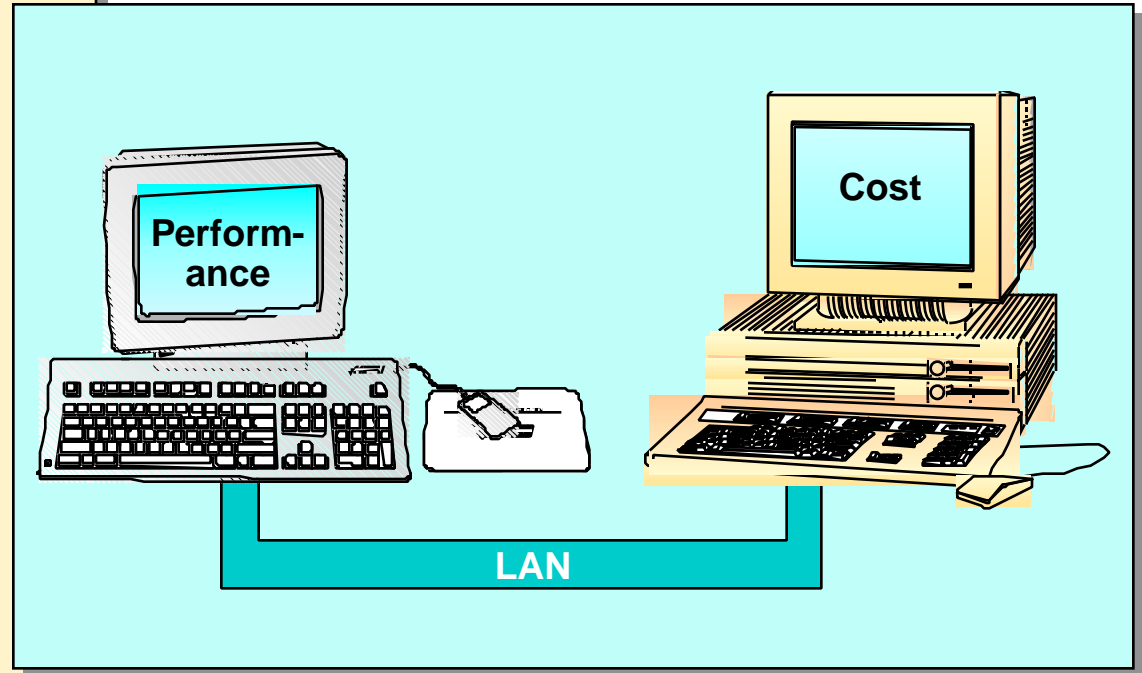
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AM3 VALIDATION SCENARIO

- **MISSILE SYSTEM: HYPOTHETICAL PRECISION GUIDED MUNITION (PGM)**
- **TRADE STUDY VARIABLES:**
 - WARHEAD MASS
 - TOTAL IMPULSE
 - OPTICAL DIAMETER
 - DETECTOR MATERIAL
- **PERFORMANCE VARIABLES:**
 - WEIGHT
 - CONTROLLABILITY
 - MAXIMUM RANGE
 - RECOGNITION RANGE
 - STABILITY MARGINS
 - MISS DISTANCE
 - PROBABILITY OF KILL
- **COST VARIABLES:**
 - FIRST UNIT COST
 - LIFE CYCLE COST



**SCENARIO DEMONSTRATES MISSILE CONCEPT OPTIMIZATION BY EMPLOYING
COST-AS-AN-INDEPENDENT-VARIABLE TECHNIQUES**



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GEOGRAPHICALLY DISPERSED ENGINEERING TEAM

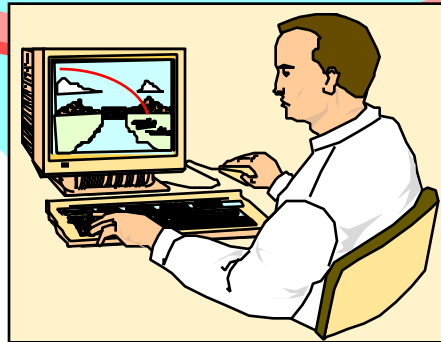
CONFIGURATION DESIGN AND ANALYSIS



COST MODELING AND ANALYSIS



SIMULATION AND PERFORMANCE ANALYSIS



LAN, WAN,
INTERNET

FEATURES

- COST-AS-AN-INDEPENDENT VARIABLE (CAIV)
- COLLABORATIVE AND DISTRIBUTIVE ENGINEERING
- VIRTUAL PROTOTYPING
- SEAMLESS MULTI-DISCIPLINE SOFTWARE INTEGRATION
- KNOWLEDGE-BASED DESIGN AND ANALYSIS
- COMMON MAN-MACHINE INTERFACE
- ELECTRONIC DATA EXCHANGE

BENEFITS

- INCREASES SOLUTION SPACE
- PROMOTES KNOWLEDGE SHARING
- REDUCES DESIGN CYCLE TIME
- ELIMINATES RE-ENGINEERING OF NOMENCLATURE, SIGN CONVENTIONS, COORDINATE FRAMES, AND UNITS
- AVOIDS DUPLICATION OF EFFORT
- PRESERVES LEGACY CODE INVESTMENT
- IMPROVES STANDARDS OF QUALITY

OFFERS A SIGNIFICANT REDUCTION IN TIME REQUIRED FOR CONCEPT DEFINITION, TECHNOLOGY INSERTION, OR REVERSE ENGINEERING STUDIES

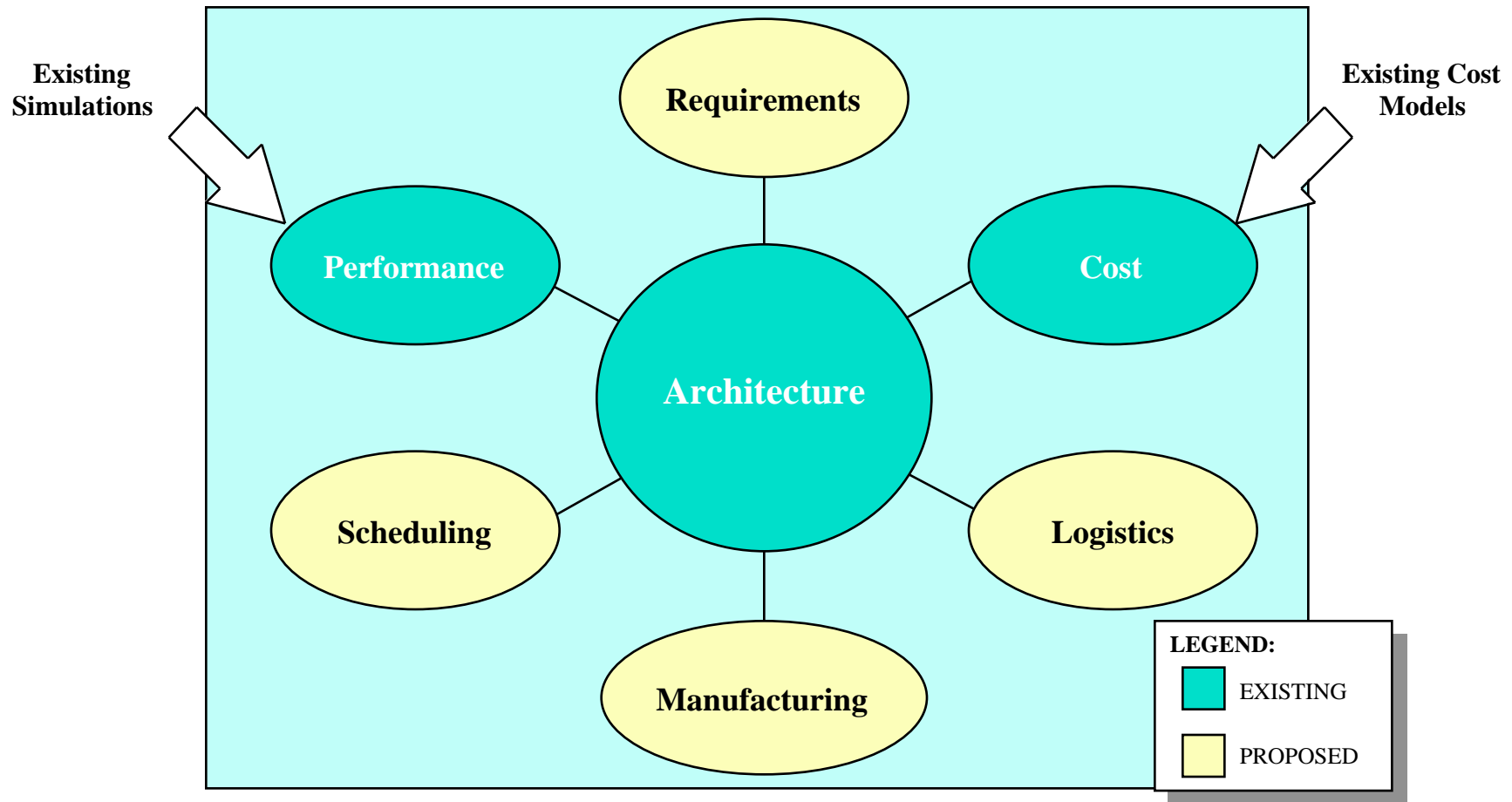


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COLLABORATIVE VIRTUAL PROTOTYPING SYSTEM (CVPS)



***REDUCES THE COST AND SCHEDULE ASSOCIATED WITH RESEARCH,
DEVELOPMENT, AND ACQUISITION OF FUTURE WEAPON PROGRAMS***

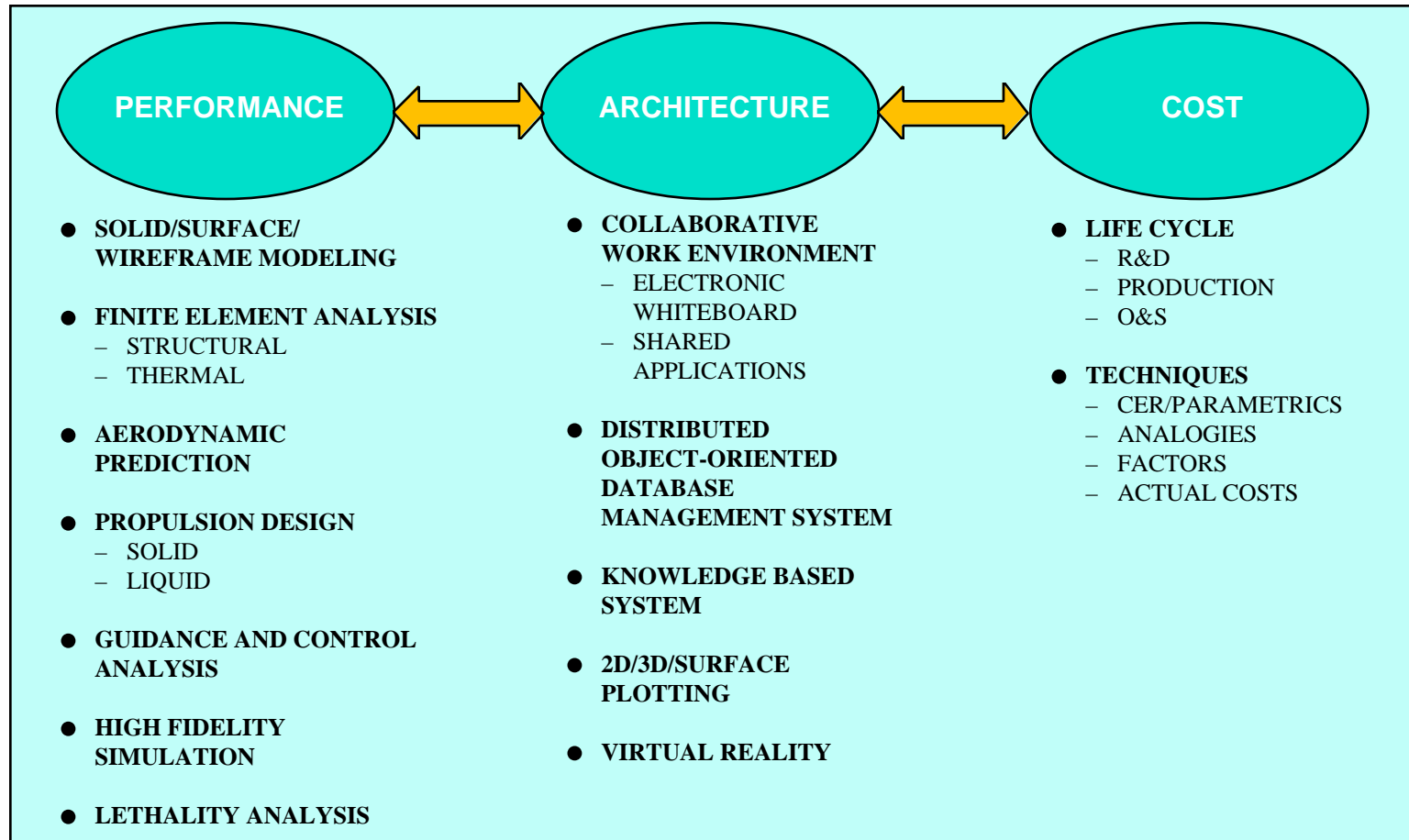


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FACILITATES COST-AS-AN-INDEPENDENT VARIABLE (CAIV)



***COST AND PERFORMANCE LINKED THROUGH OPEN AND
SCALABLE ARCHITECTURE***

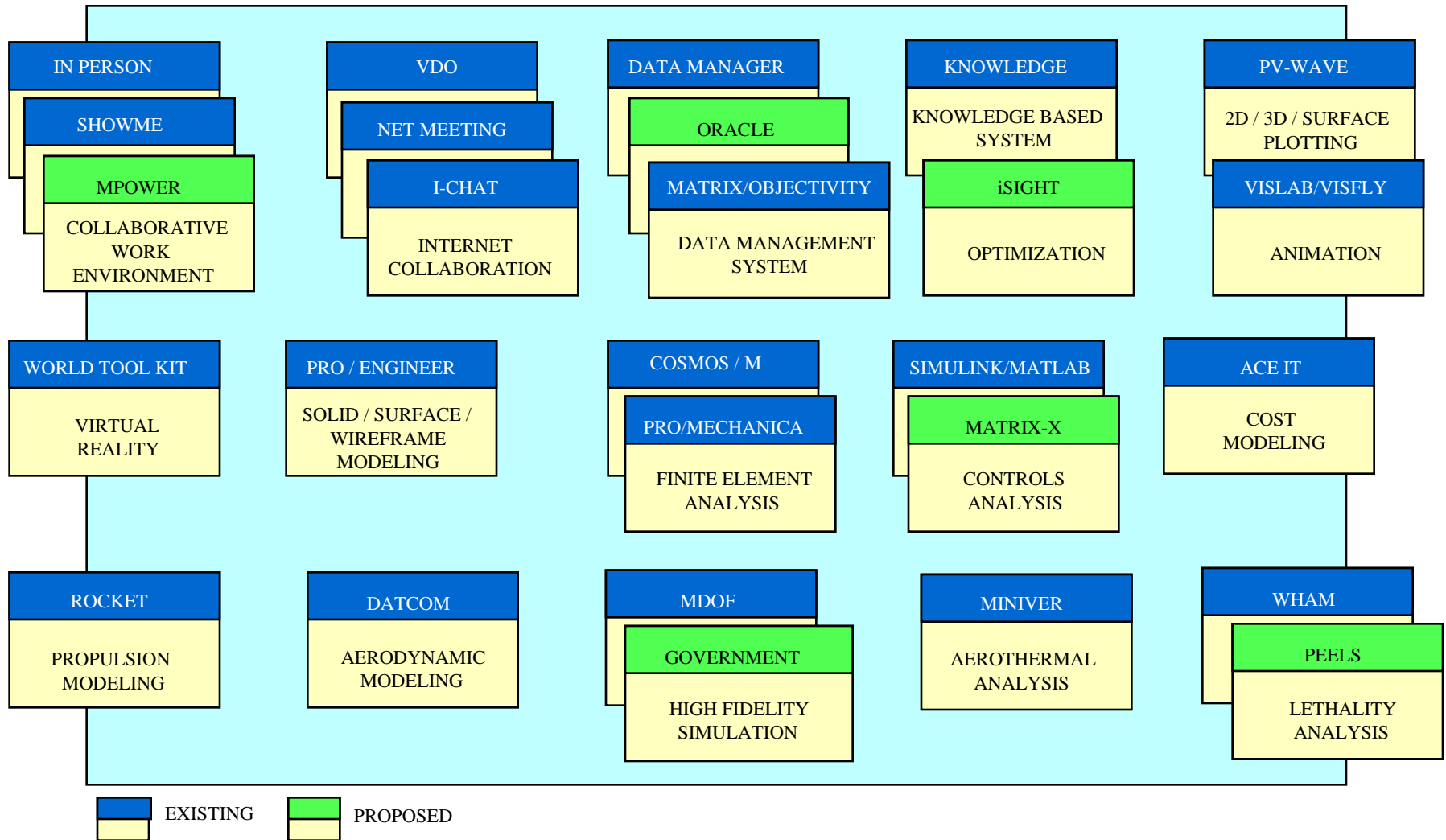


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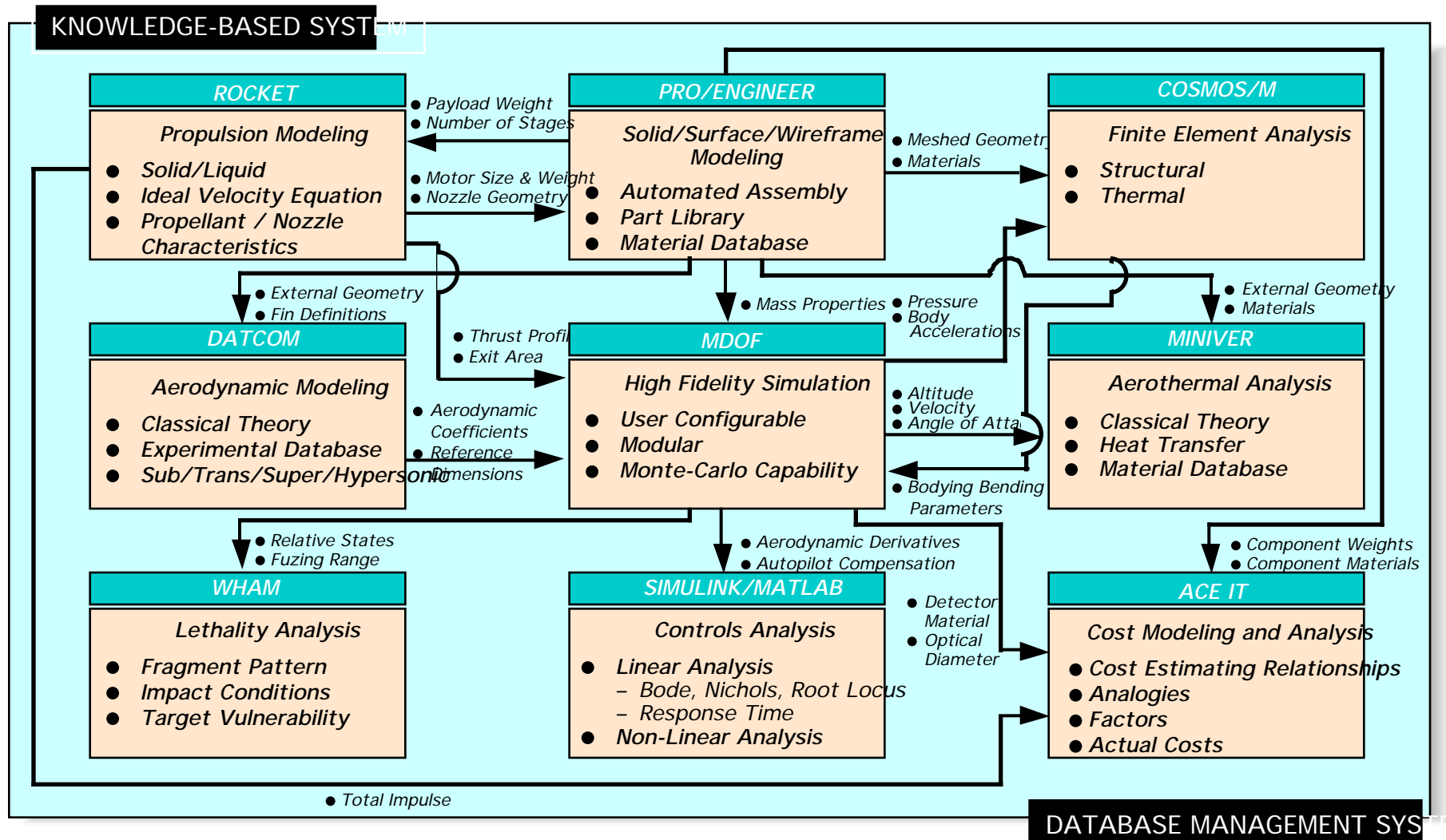
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ARCHITECTURE LEVERAGES COTS/GOTS SOFTWARE



SEAMLESSLY INTEGRATED SOFTWARE ARCHITECTURE



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AM3 MISSILE CONCEPT OPTIMIZATION SCOREBOARD

Configuration	Configuration	Seeker Type	Optical Diameter (cm)	Motor Impulse (Nt-sec)	Explosive Mass (kg)	Total Mass (kg)	Maximum Range (km)	Recognition Range (km)	Miss Distance (m)	First Unit Cost (K\$)	Life Cycle Cost (M\$)	Performance Index
ORD Goal						400.0	52.5	8.00	3.00	950	2,050.000	
AGM-XA	Baseline	IIR	7.5	45300	100	331.5	52.0	8.15	1.58	931	1,959.828	0.877
AGM-XB-1	R/M 1 W/H 1	IIR	7.5	45300	100	331.5	52.0	8.15	1.58	931	1,959.828	0.877
AGM-XB-2	R/M 1 W/H 2	IIR	7.5	45300	125	356.5	51.5	8.12	2.13	936	1,969.143	0.782
AGM-XB-3	R/M 1 W/H 3	IIR	7.5	45300	150	381.5	51.0	8.11	2.82	941	1,977.614	0.714
AGM-XB-4	R/M 2 W/H 1	IIR	7.5	61425	100	342.8	53.0	8.16	1.46	936	1,969.600	0.904
AGM-XB-5	R/M 2 W/H 2	IIR	7.5	61425	125	367.8	52.5	8.13	1.94	942	1,978.889	0.806
AGM-XB-6	R/M 2 W/H 3	IIR	7.5	61425	150	392.8	52.0	8.12	2.43	946	1,987.337	0.744
AGM-XB-7	R/M 3 W/H 1	IIR	7.5	78000	100	354.4	55.0	8.16	1.40	942	1,979.617	0.920
AGM-XB-8	R/M 3 W/H 2	IIR	7.5	78000	125	379.4	54.5	8.14	1.85	947	1,988.878	0.820
AGM-XB-9	R/M 3 W/H 3	IIR	7.5	78000	150	404.4	54.0	8.11	2.22	952	1,997.316	0.766
AGM-XB	R/M ? W/H ?	IIR	7.5	78000	100	354.4	55.0	8.16	1.40	942	1,979.617	0.920
AGM-XC	OTS Rocket Motor	IIR	7.5	53625	100	339.3	52.5	8.10	1.34	903	1,955.472	0.938
AGM-XD-1	D/M 1 O/D 1	IIR	5	53625	100	337.8	52.5	4.59	1.58	836	1,835.762	0.849
AGM-XD-2	D/M 1 O/D 2	IIR	7.5	53625	100	338.8	52.5	6.51	1.38	868	1,892.558	0.915
AGM-XD-3	D/M 1 O/D 3	IIR	10	53625	100	339.8	52.5	9.40	1.31	896	1,942.337	0.965
AGM-XD-4	D/M 2 O/D 1	IIR	5	53625	100	338.3	52.5	5.50	1.45	872	1,898.708	0.882
AGM-XD-5	D/M 2 O/D 2	IIR	7.5	53625	100	339.3	52.5	8.15	1.34	903	1,955.472	0.938
AGM-XD-6	D/M 2 O/D 3	IIR	10	53625	100	340.3	52.5	10.20	1.26	931	2,005.060	0.983
AGM-XD-7	D/M 3 O/D 1	IIR	5	53625	100	338.5	52.5	7.20	1.40	898	1,945.314	0.910
AGM-XD-8	D/M 3 O/D 2	IIR	7.5	53625	100	339.5	52.5	9.89	1.30	929	2,002.060	0.967
AGM-XD-9	D/M 3 O/D 3	IIR	10	53625	100	340.5	52.5	11.73	1.19	957	2,051.796	Over Budget
AGM-XD	D/M ? O/D ?	IIR	10	53625	100	340.3	52.5	10.20	1.26	931	2,005.060	0.983
AGM-XE	OTS Seeker	TV	7.5	53625	100	334.0	52.5	13.05	1.56	931	1,893.131	0.954
AGM-XF	OTS Seeker	LASER	7.5	53625	100	335.6	52.5	9.07	1.26	931	1,946.851	0.977
AGM-XG	OTS Seeker	RF	N/A	53625	100	341.6	52.5	17.78	2.32	931	2,267.042	Over Budget

Baseline

Optimum Warhead/
Rocket Motor

Optimum Seeker

Exceeds Budget

P3I Alternatives

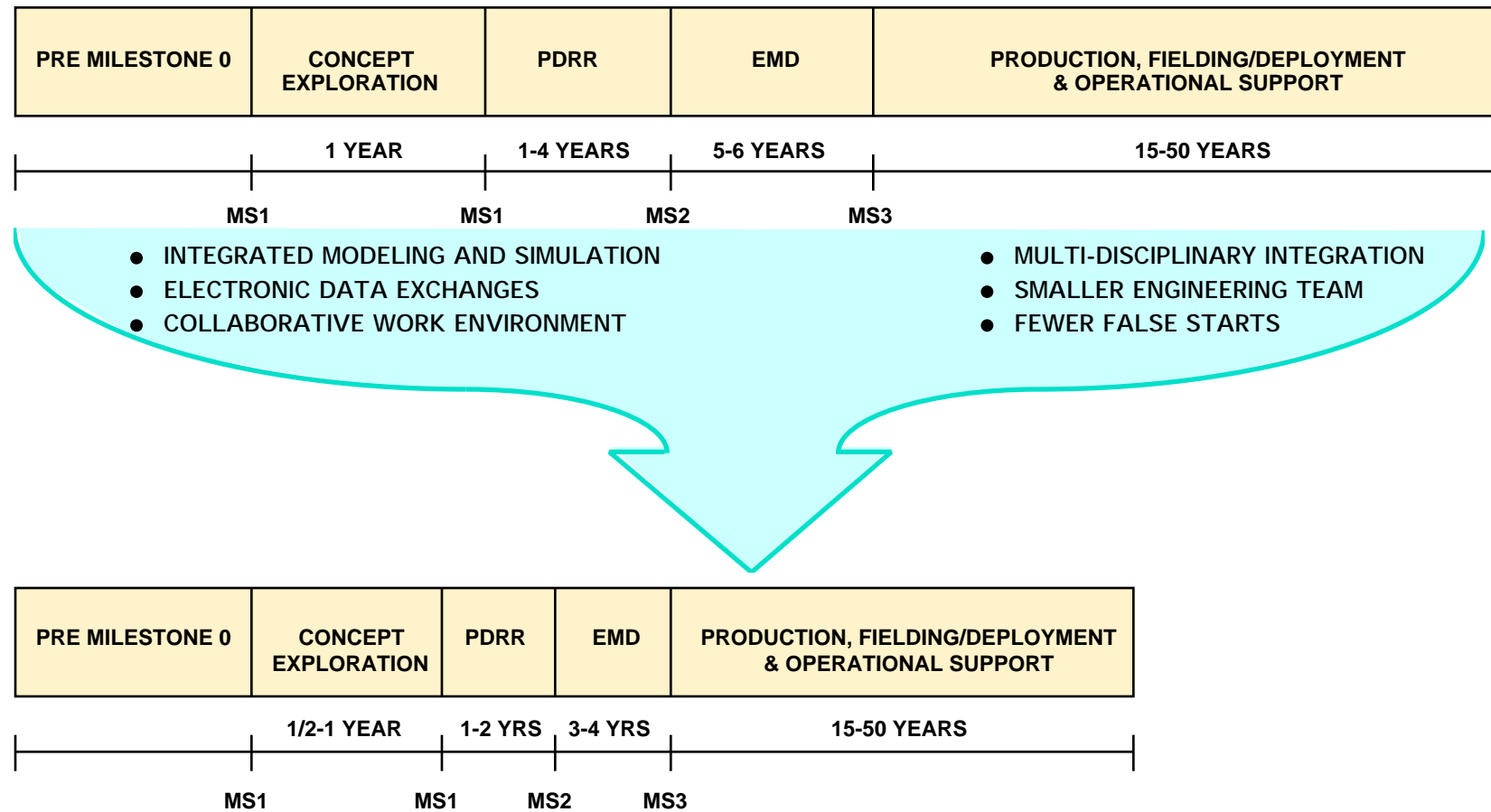


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CYCLE TIME SAVINGS



CVPS WILL RESULT IN A 15-25% DEVELOPMENT CYCLE TIME SAVINGS



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CURRENT APPLICATIONS

- **CONCEPT DEFINITION STUDIES**
 - QUICK TURNAROUND
 - MULTIPLE CONFIGURATIONS
- **TECHNOLOGY INTEGRATION**
 - SEEKER SUBSYSTEMS
 - ADVANCED GUIDANCE AND CONTROL
- **PACKAGING STUDIES**
 - WEAPON DERIVATIVES
 - PAYLOAD STUDIES
 - EXISTING BOOSTERS
- **REVERSE ENGINEERING**
 - FOREIGN WEAPONS
 - INCOMPLETE DESIGN INFORMATION
- **COST-AS-AN-INDEPENDENT-VARIABLE (CAIV)**
 - DoD MANDATE
 - COST-PERFORMANCE TRADE OFFS



SUMMARY

- **COST-AS-AN-INDEPENDENT-VARIABLE (CAIV) MAJOR ELEMENT OF ACQUISITION REFORM**
- **PRODUCT IMPROVEMENT AND TECHNOLOGY INSERTION CAN BE FULLY INVESTIGATED ACROSS ALL ENGINEERING DISCIPLINES**
- **OPEN AND SCALEABLE ARCHITECTURE ALLOWS INTEGRATION OF EXISTING SIMULATIONS**
- **SEAMLESS MULTI-DISCIPLINED ARCHITECTURE ALLOWS WEAPON DEVELOPMENT WITH SMALLER DESIGN TEAM**
- **KNOWLEDGE-BASED DESIGN AND ANALYSIS APPROACH CAPTURES EXPERIENCE OF SENIOR PERSONNEL**
- **COLLABORATIVE AND DISTRIBUTIVE WORK ENVIRONMENT REDUCES DESIGN CYCLE TIME AND COST WITH IMPROVED QUALITY**

**COLLABORATIVE MODELING AND SIMULATION ENVIRONMENTS ESSENTIAL FOR
WAR-FIGHTING IN THE INFORMATION AGE**

